Department of Defense, Space Test Program

SDTW, SDSG/OL-Y

Human Spaceflight Payloads Office

DARPA InSPIRE Industry Day
Lt Matthew Gartmann, USAF

Briefing Objectives

- **Introduce the DoD Space Test Program and Define Applicable STP Services**
- **Introduce NASA Shuttle/ISS Requirements Documentation**
- **Introduce the NASA Payload Integration and Safety Process**

Space Test Program Mission

- **Originally chartered by OSD in 1965**
  - **Revalidated by SecDef Perry in 1995**
- **Fly the maximum number of DoD experiments consistent with priority, opportunity, and funding**
  - **STP works from a prioritized list of sanctioned experiments, uses available budget, and searches for the most cost effective means to reach space.**
  - **STP funds small launch vehicle, spacecraft, payload integration, and orbital operations for 1 year**
  - **STP serves all of DoD-- reduces duplication --- saves YOU money!!!**

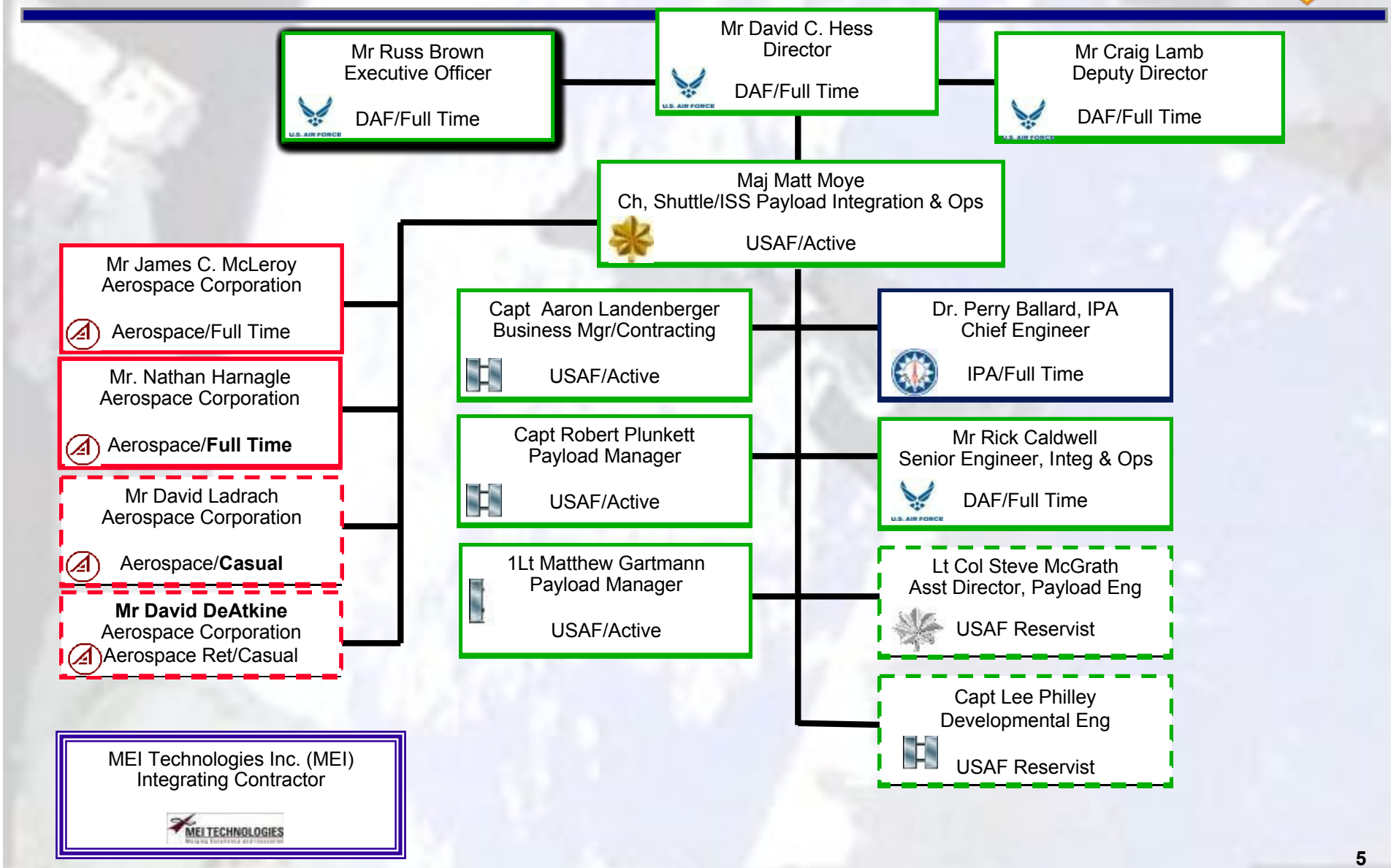
STP is the primary provider of access to space for DoD Research and Development (R&D) Payloads

SMC/Operating Location-Y (OL-Y) Mission

SINGLE-FACE-TO-CUSTOMER BETWEEN DoD AND NASA

- Located at NASA's Johnson Space Center (pictured)
- Provide timely space flight of DoD primary and secondary payloads
- Exploit the use of the Shuttle as an R&D space laboratory
- Explore the utility of man-in-space to accomplish the DoD mission
- Monitor the evolution of human space flight and take advantage of future DoD space flight opportunities
- Explore and exploit the use of the Space Station as an R&D platform for DoD sponsored experiments

Human Spaceflight Payloads Office



OL-Y
Support Objectives

- **Provide Project Management for Physical Integration of Payload to Flight Support Hardware**
- **Provide Project Management Support to Complete the Shuttle/ISS Safety and Integration Processes**
- **Provide Technical Integration Support to Avoid Payload Design, Schedule, and Cost Impacts**
- **Minimize Time-to-Flight Consistent with the Payload's Requirements and Capabilities**
- **Assure the Payload is Ready for Flight and Completes the Mission Objectives**

OL-Y Roles and Responsibilities

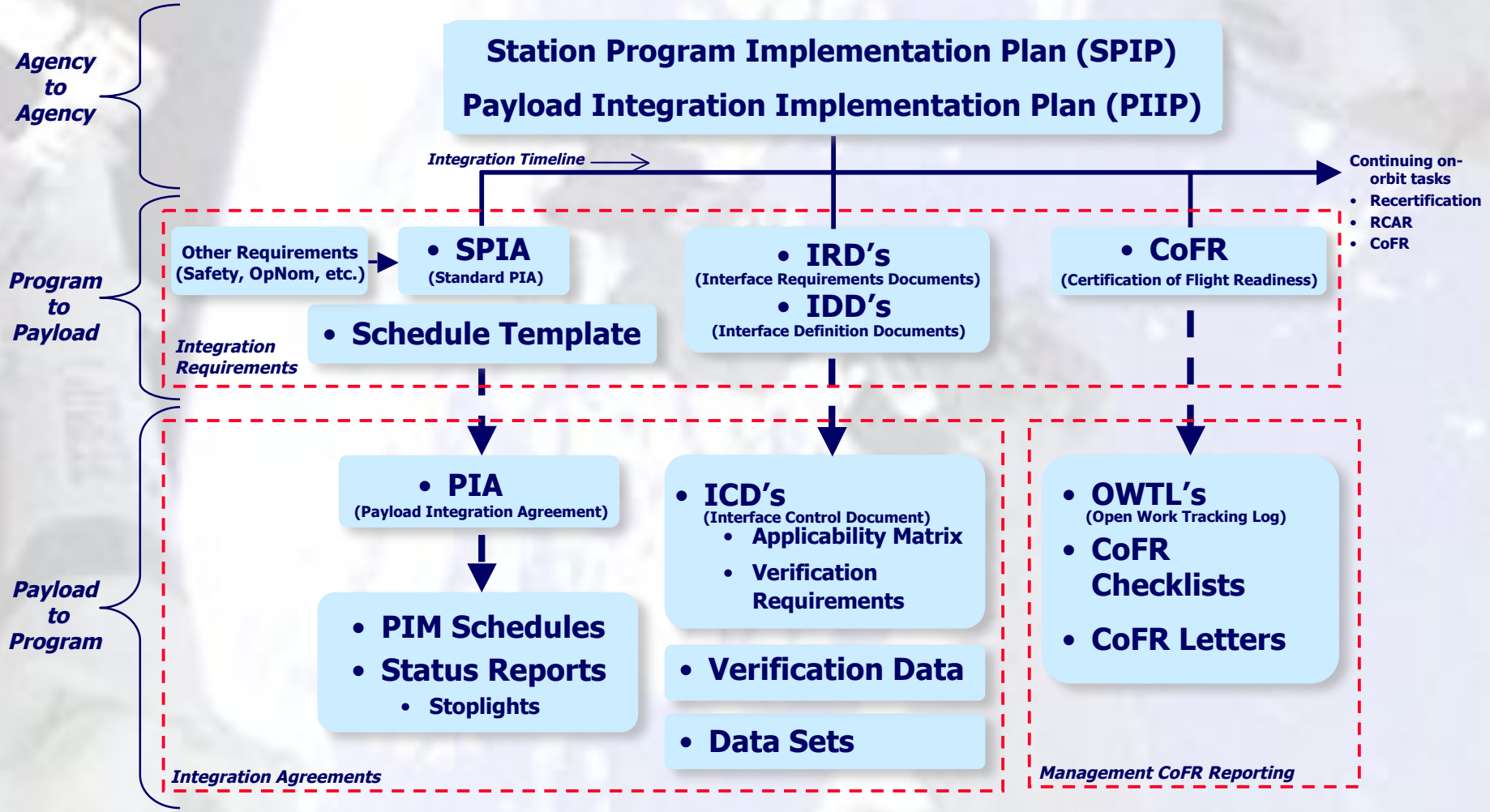
- **OL-Y coordinates with Space Shuttle/Station Program (SSP) for payload integration (as necessary)**
  - **Principal Investigator (PI) is STP customer**
  - **STP is Space Shuttle/Station Program customer**
- **OL-Y prepares initial agreements and forms (with inputs from PI/PD)**
  - **MOA between PI and STP**
  - **Mission Evaluation Request (Request for ISS Flight)**
- **OL-Y is involved in all aspects of experiment integration and SSP operations**
  - **Provide programmatic and technical oversight and support to payload definition, design, and integration activities**
  - **Interface directly with SSP for programmatic and technical issues**
  - **Draft, coordinate and formally submit deliverables to SSP**
  - **Develop and maintain an overall integration schedule**
  - **Conduct and/or participate in integration telecons, technical meetings and reviews**

PI Roles and Responsibilities

- The Principal Investigator (PI) is responsible for development and delivery of the experiment hardware, and for providing the technical information required to integrate and operate the experiment; PI is responsible for on-orbit data collection
- PI will keep OL-Y informed of all major activities, meetings, telecons and problems
  - Provide integration status and schedule info on hardware development
  - Provide integration and safety inputs to OL-Y (as required)
  - Participate in integration and safety telecons, meetings and reviews
  - Participate in regular status telecons with OL-Y
- PI prepares and updates experiment development schedule and provides to OL-Y
- PI prepares applicable safety attachments (with assistance from OL-Y)

- **The mountains of paperwork required by Manned Spaceflight seem excessive! NASA takes the safety of the crew, the Shuttle and the International Space Station very seriously.**
- **Payloads have strict safety requirements, but it's not enough just to meet requirements – NASA requires "objective evidence" that each requirement is met.**

ISS Integration Documents (non-safety)



ISS Requirements & Agreements

- **Key requirements documents for payloads using the ISS, tailored based on unique payload requirements**

Safety Requirements Documents

- NSTS 1700.7B, "Safety Policy and Requirements for Payloads using the Space Transportation System"
- NSTS 1700.7B, ISS Addendum, "Safety Policy and Requirements for Payloads Using the International Space Station"
- NSTS/ISS 13830, "Payload Safety Review and Data Submittal Requirements for Payloads Using the ISS"
- NSTS/ISS 18798, "Interpretations of NSTS/ISS Payload Safety Requirements"
- KHB 1700.7, "Space Shuttle Ground Safety Handbook"
- SSP 52005, "Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures"
- SSP 57025, "ISS Payload Interface System Fault Tolerance Document"

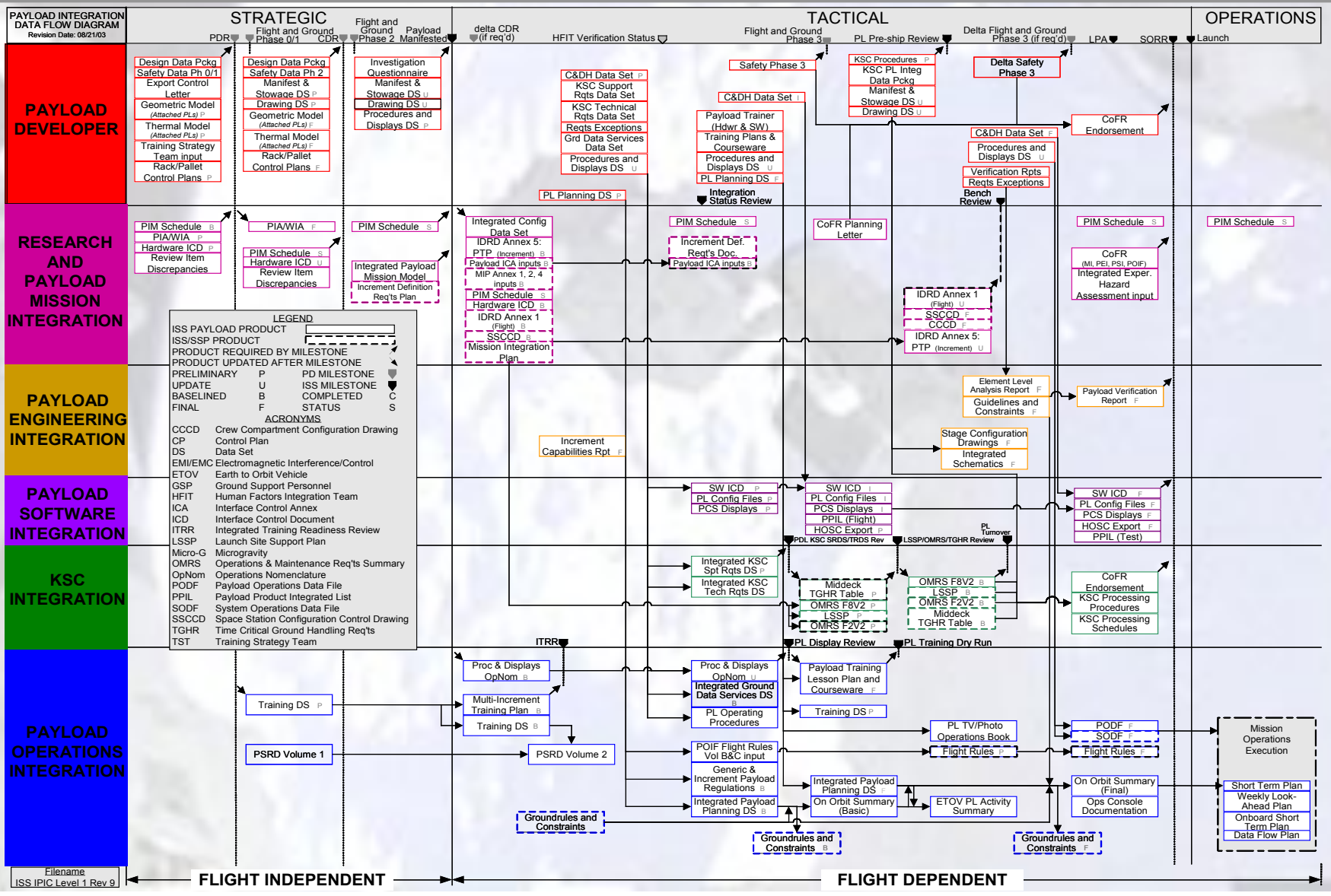
Standard Requirements Documents (partial listing)

- SSP 52000-PDS, "Payload Data Sets Blank Book"
- SSP 52054, "ISS Program Payloads Certification of Flight Readiness Implementation Plan, Generic"
- SSP 57000, "Pressurized Payloads Interface Requirements Document"
- SSP 57003, "Attached Payload Interface Requirements Document"
- SSP 57061, "Standard Payload Integration Agreement for Attached Payloads"
- SSP 57072, "Standard Payload Integration Agreement for Pressurized, Small, and ExPRESS/WORF Rack Payloads"
- IP requirements also exist for integration into partner modules, elements, or facilities

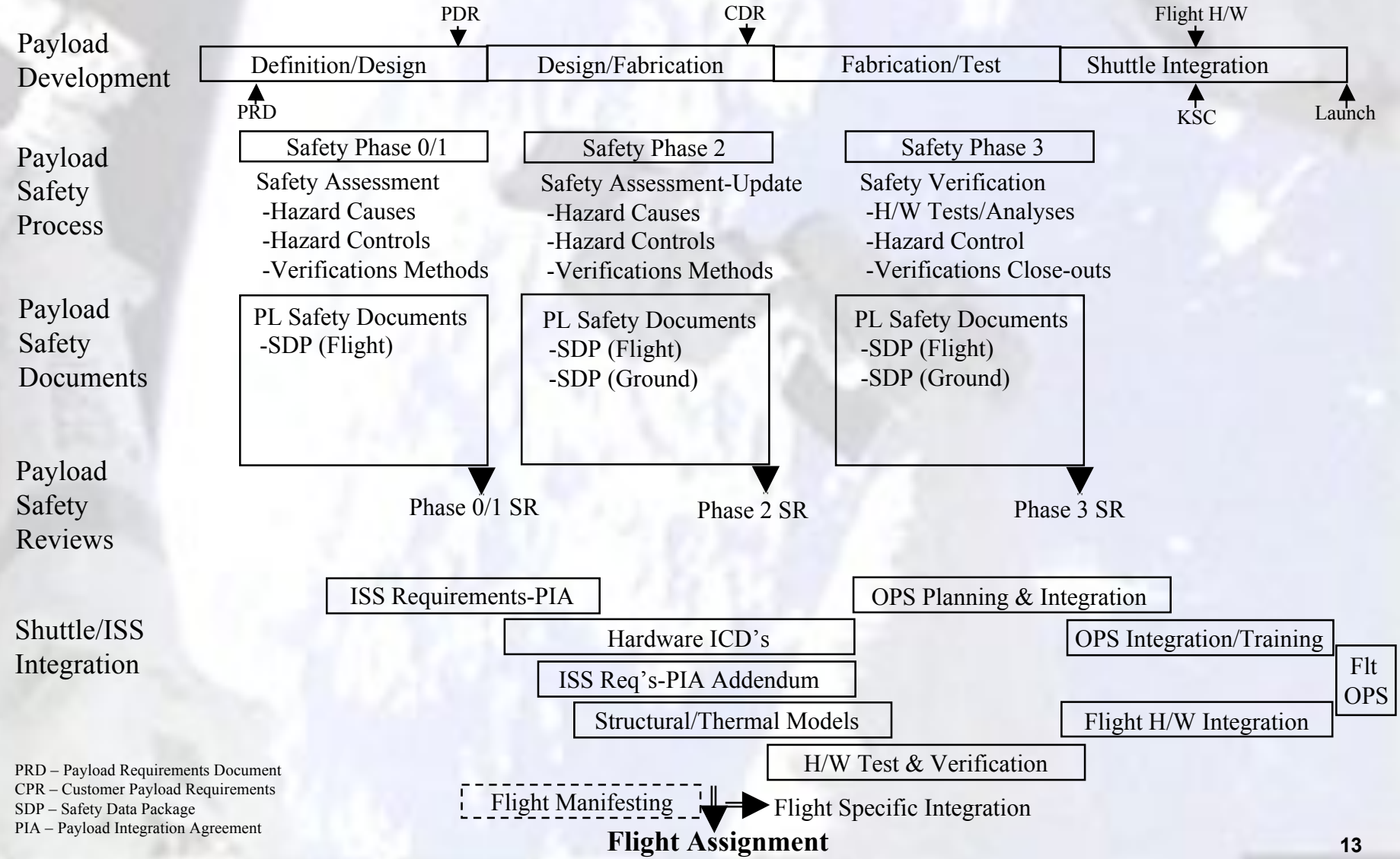
Joint Agreements are required in the following disciplines

- Safety Requirements
- Physical Interface Requirements
- Human Factors Requirements
- Electrical/Thermal Interface Requirements
- Command and Data Downlink Requirements
- Operational Requirements
- Crew Training Requirements
- Transportation to/from Orbit Requirements
- Ground Data Services
- EVA/EVR Requirements

Top Level NASA Shuttle/ISS Integration and Safety Overview

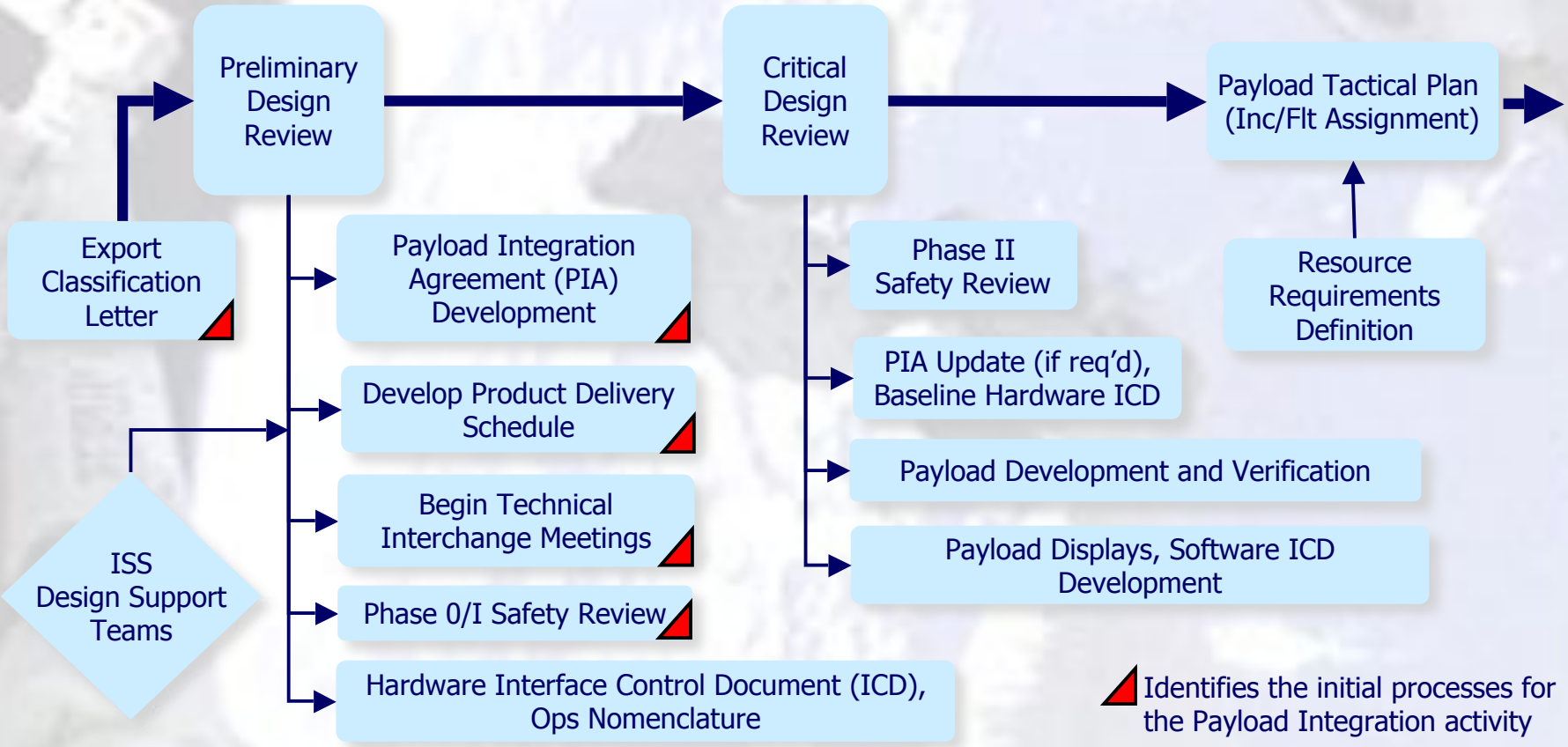


Top Level NASA Shuttle/ISS Integration and Safety Overview

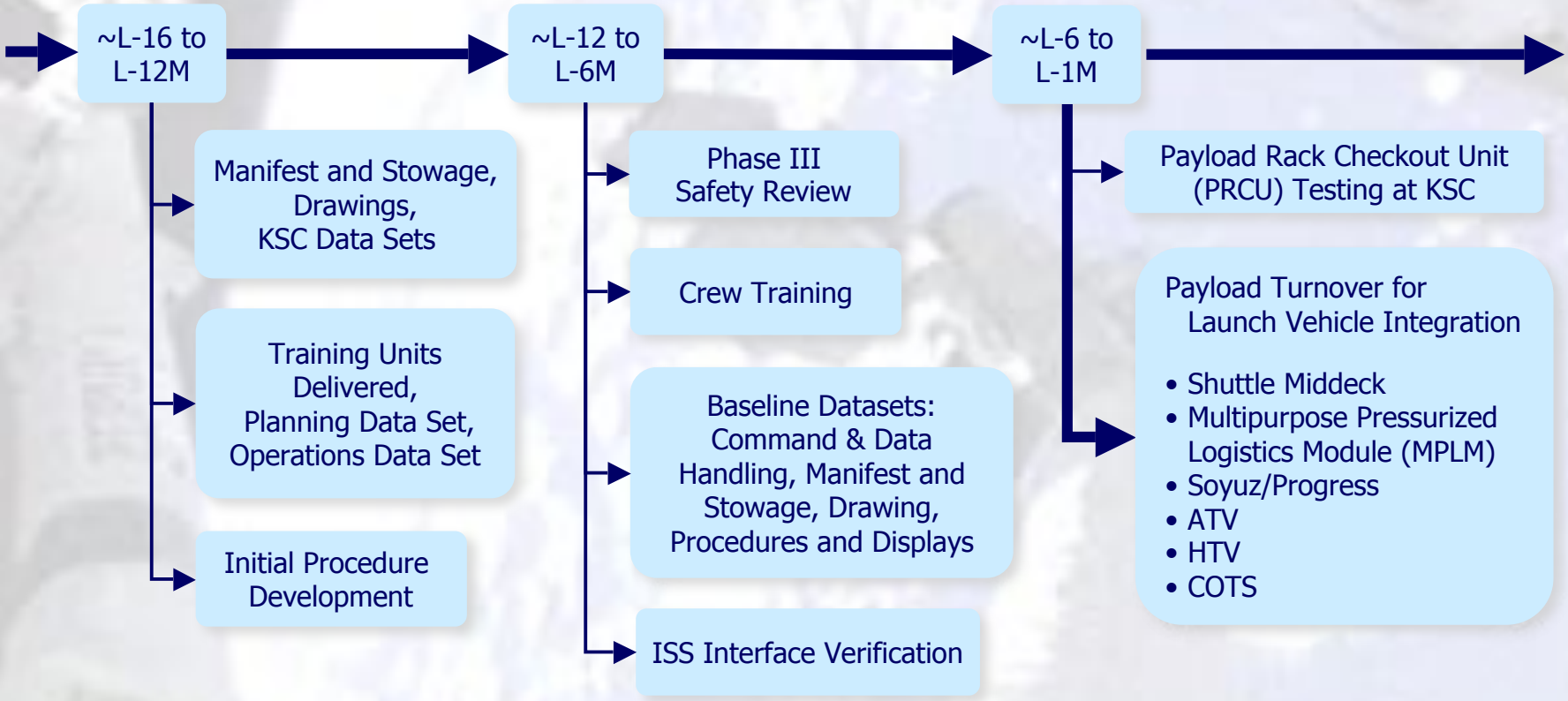


PRD – Payload Requirements Document
CPR – Customer Payload Requirements
SDP – Safety Data Package
PIA – Payload Integration Agreement

NASA Integration Overview (1 of 3)



NASA Integration Overview (2 of 3)

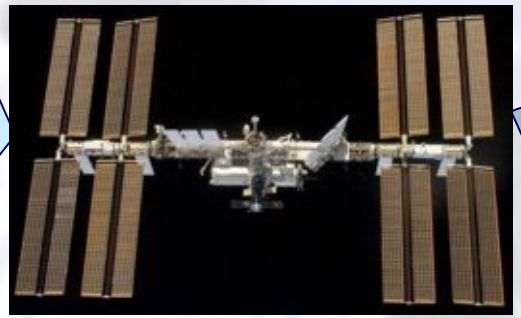


NASA Integration Overview (3 of 3)

Certification of Flight Readiness → Launch → On-Orbit Operations → Landing/ Jettison → Post-Landing Payload Processing

- CoFR documentation addresses both hardware launch and Stage operations

- Hardware De-integration
- Sample Return



Requirements Documentation and Verification Paperwork

Safety Review Objectives

- **Safety Technical Interchange Meeting (TIM)**
  - **To obtain Payload Safety Review Panel safety design concurrence or assist in interpreting safety requirements prior to safety reviews**
  - **Safety TIM information has to be submitted 14 calendar day prior to the TIM**
- **Phase 0**
  - **Assist the PO in identifying hazards, hazard causes, and applicable safety requirements early in the development of the payload.**
  - **Adequately describe the hazard potential.**
  - **Answer questions regarding the interpretation of the safety requirements or the implementation procedures of this document.**
  - **Provide guidance to the PO for preparing the safety data required for subsequent safety reviews.**
- **Phase I ("As Conceptualized")**
  - **The purpose of the phase I safety review is to obtain Payload Safety Review Panel (PSRP)/Ground Safety Review Panel (GSRP) approval of the updated safety analysis that reflects the preliminary design and operations scenario of the payload**

Note: Safety reviews are held 45 calendar days after a SDP is submitted

Safety Review Objectives

- **Phase II ("As Designed")**
  - **Obtain PSRP/GSRP approval of your safety analysis/assessment that reflects the critical design review level and operations scenario of the payload, flight and ground**
  - **Design Changes after Phase II require going back to the safety panel, possibly for a Safety TIM or Delta-Phase-II**
- **Phase III ("As Built")**
  - **Obtain PSRP/GSRP approval of your safety analysis/assessment and safety compliance data that reflects the safety verification findings. The focus of this review is to assess safety verification testing and analysis results of the as-built as-tested flight hardware**

Safety Documentation

- **Safety Data Package**
  - Description of hardware
  - Safety Assessment
  - Hazard Reports
- **Supporting Documentation**
  - Fracture Control Plan (FCP)
  - Structural Verification Plan (SVP)
  - Mechanical Systems Verification Plan (MSVP)
  - Fracture Control Summary Report (FCSR)
  - Structural Verification Report (SVR)
  - Mechanical Systems Verification Report (MSVR)
  - Battery Test Report
  - Materials List

Safety Documentation Objectives

- **Flight Safety Data Package**
  - Description of hardware, including subsystems, and mission scenario
  - Identify safety-critical subsystems and their operations.
  - Description of operations and hardware interfaces.
  - Description of crew interfaces.
  - Identify battery types, their uses, manufacture, and applications.
  - Safety Assessment
  - Hazard Reports and supporting data
- **Ground Safety Data Package (depends on KSC ground activities)**
  - Description of hardware, including subsystems, and mission scenario
  - Ground Support Equipment description
  - Ground Operations, planned and contingency
  - Safety Assessment
  - Hazard reports as applicable
- **Phase II and Phase III safety data packages should be updated to coincide with the maturity of the hardware**

Safety Definitions

- **Critical Hazard**
  - **A hazard which can result in damage to STS equipment, a nondisabling personnel injury, or the use of unscheduled safing procedures that affect operations of the Orbiter or another payload.**
- **Catastrophic Hazard**
  - **A hazard which can result in the potential for: a disabling or fatal personnel injury; or loss of the Orbiter, ground facilities or STS equipment**
- **Inhibit**
  - **A design feature that provides a physical interruption between an energy source and a function (e.g., a relay or transistor between a battery and a pyrotechnic initiator, a latch valve between a propellant tank and a thruster, etc.)**
  - Independent Inhibits **- Two or more inhibits are independent if no single credible failure, event, or environment can eliminate more than one inhibit.**
- **Control**
  - **A device or function that operates an inhibit is referred to as a control for an inhibit and does not satisfy inhibit requirements. The electrical devices that operate the flow control devices in a liquid propellant propulsion system are exceptions in that they are referred to as electrical inhibits**

Hazards

- Flight Payload Standardized Hazard Control Report Form 1230 can used for generic hazards if it meets the control as specified on the form.
- Any identified hazard not meeting the controls on the JSC form 1230 will require a unique HR

Safety Guidance

- Areas typically scrutinized:
  - Structures
  - Mechanisms
  - Materials
  - Batteries
  - Electrical
  - Thermal
  - Pressure systems
  - Propulsion & recontact
  - Etc.
- Following charts give guidance to safety verification resolutions

Safety Guidance - Structures

- **Structures**
  - **Proposed Structural Verification Plan in accordance with NSTS 14046**
  - **Fracture Control Plan in accordance with NASA-STD-5003 Methodology for assurance of fastener integrity (JSC 23642 Rev D)**
  - **Composite materials require special approval**
  - **A structural model of the payload will be required to be delivered to STP as part of the integration effort**
  - **The payload my be required to perform a venting analysis to show venting sufficient to accommodate ascent/descent profiles**
  - **Draft SVP and FCP by Phase I, Final SVP and FCP by Phase II. Structural analysis results by Phase III.**
  - **Rotating Equipment is not fracture critical if less than 8” diameter and less than 8000 rpm at maximum possible current. Show structural containment.**

Safety Guidance – Critical Mechanisms

- **Critical Mechanisms**
  - **Identification of safety-critical mechanisms**
  - **Identification of applicable areas of holding or operating force or torque margin requirements**
  - **Identify the planned verification approach (test or analysis)**
  - **Preliminarily address the matrix of requirements in NSTS 18798 (Interpretation Letter MA-00-057) for all mechanisms that have a catastrophic hazard potential**
  - **Assess mechanisms for "Design for Minimum Risk" applicability**
  - **Draft Mechanical Systems Verification Plan (MSVP) (as applicable per the PSRP) by Ph I, Final MSVP by Ph II.**
  - **Dimensional Analysis at temperature extremes by Ph II**

Safety Guidance - Materials

- Approach used to assure materials compatibility
- Preliminary Materials Identification & Usage List (MIUL).
- Identify any materials that are stress-corrosion sensitive (non-Table 1) in accordance with MSFC-STD-3029
- Identify any materials that do not have an A-rating in accordance with MAPTIS
- Final materials list prior to Phase III
- PC boards that are conformally coated usually do not require detailed materials list for the board contents

Safety Guidance - Batteries

- By Phase I:
  - List of type and number of battery cells, cell size (capacity), cell chemistry, cell manufacturer, and model number
  - Complete EP-Form-03, Battery Design Evaluation Form
  - Identify the battery packaging and application
  - Address on-orbit battery charging (intentional or unintentional)
  - Describe ground battery top-off charging operations in the SDP
  - Preliminary battery circuitry diagrams, including charging circuit, wire sizing and circuit protection showing compliance with NSTS 1700.7B and KHB 1700.7
  - Get approval for qualification and acceptance testing plan
- By Phase II
  - Final cell configuration, packaging design and circuit diagrams
- By Phase III
  - Battery test results

Safety Guidance - Electrical

- Wire sizing & fusing derated to NASA requirements NSTS/ISS 18798 (TA-92-038)
  - Use 150°C-rated wire or better
  - Example: MIL-22759 is a commonly used wire for flight hardware
- Block Diagrams and schematics:
  - Preliminary block diagrams at Phase I
  - Final block diagrams and schematics at Phase II
  - As-built/as-tested schematics at Phase III
- RF transmission power and frequencies needed to determine required safety controls

Safety Guidance – Thermal

- Thermal conditions needs to be considered as part of the safety assessment
  - Structure
  - Batteries
  - Pressure system
- Payload thermal model and/or analysis may be required to be delivered to STP as part of the integration effort

Integration and Safety Resources
Where to go?

- When there is a question of how to proceed through the NASA integration and safety processes, always, refer to the governing NASA requirements documents.


U.S. AIR FORCE


SPACE TEST PROGRAM
PATHFINDER FOR DoD SPACE SYSTEMS

Questions?

U.S. AIR FORCE

SPACE TEST PROGRAM

PATHFINDER FOR DoD SPACE SYSTEMS

Backup Charts

Mission Integration Acronyms

Mission Integration Acronyms

HELP !

ACO	Assembly and Checkout Officer
CCCD	Crew Compartment Configuration Drawing
CDR	Critical Design Review
CEF	Change Evaluation Form
COC	Certificate of Compliance
CoFR	Certificate of Flight Readiness
CSM	
DS	Data Set
EC	Export Control
EIRR	External Independent Readiness Review
FPM	Flight Payload Manager
FSR	Flight Safety Review
GSR	Ground Safety Review
HAZMAT	Hazardous Materials table
HR	Hazard Report
ICA	Interface Control Annex
ICD	Interface Control Document
IDRD	Increment Definition Requirements Document
IEHA	Integrated Experiment Hazard Assessment
IPC	Internal PIRN Coordination
IPE	Increment Payload Engineer
IPM	Increment Payload Manager
IRN	Interface Revision Notice
LPA	Launch Package Assessment
LSE	Laboratory Support Equipment
ME	Mandatory Evaluator
MEL	Mandatory Evaluator List
MIP	Mission Integration Plan
MOD	Mission Operations Directorate
MORD	Medical Operations Requirements Document
MR	Manifest Request
OOS	On-orbit Operations Summary
OPNOM	Operations Nomenclature
OWTL	Open Work Tracking Log
PALS	Program Automated Library System
PCB	Payloads Control Board
PDR	Preliminary Design Review
PHCM	Payload Hazard Control Matrix
PIA	Payload Integration Agreement
PIM	Payload Integration Manager
PIRN	Payload Interface Revision Notice
PMIT	Payload Mission Integration Team
PML	
PMR	Program Manager Review
PSR	Payload Safety Review
PTA	
PTP	Payload Tactical Plan
PTR	PIRN Technical Review
PVP	Payload Verification Plan
PVTL	Payload Verification Tracking Log
RDMA	Risk Data Management Application
RID	Review Item Discrepancy
RPO	Research Program Office
SAR	Systems Acceptance Review
SIA	Stowage Integration Agreement
SORR	Stage Operations Readiness Review
SSCCD	Space Station Crew Compartment Drawing
SSE	Station Support Equipment
UCE	
ViPER	Vehicle Integrated Performance and Resources
VDS	Verification Data Sheet
VRDS	Verification Requirements Data Sheet

Payload Integration Integration Acronyms

Payload Engineering Integration Acronyms

HELP !

ADR	Achievable Data Rate
A&I	Assembly and Installation
C&DH	Command and Data Handling
CDR	Critical Design Review
CDS	
CE	Change Evaluator
CEF	Change Evaluation Form
CG	Center of Gravity
CI	Change Integrator
COC	Certificate of Compliance
CoFR	Certificate of Flight Readiness
CS	
CSM	Cargo System Manual
CVDS	
DSCR	Data Set Change Request
ECLSS	Environmental Control and Life Support Systems
EIRR	External Independent Readiness Review
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EPCE	Electrical Power Consuming Equipment
ESD	Electro Static Discharge
ETA	Engineering Test Article
FAR	Flight Acceptance Review
GL&C	Guidelines and Constraints
GPVP	
GSE	Ground Support Equipment
HOSC	Huntsville Operations Support Center
HRDL	High Rate Data Link
ICA	Interface Control Annex
ICD	Interface Control Document
ICDE	
ICWG	
IDD	Interface Definition Document
IDRD	Increment Definition Requirements Document
IPC	
IRN	Interface Revision Notice
iURC	interim User Requirements Collection
LRDL	Low Rate Data Link
MDM	Multiplexer/ DeMultiplexer
ME	Mandatory Evaluator
MR	Manifest Request
MRDL	Medium Rate Data Link
MSD	Mass Storage Device
NASTRAN	NASA Structural Analysis
OOS	On-orbit Operations Summary
OSB	
PCB	Payloads Control Board
PDR	Preliminary Design Review
PFE	Portable Fire Extinguisher
PIA	Payload Integration Agreement
PIRN	Payload Interface Revision Notice
PSM	Payload Systems Manual
PARR	
PSDE	
PSIVF	Payload Software Integration Verification Facility
PSPICE	
PSRP	Payload Safety Review Panel
PTE	
PTR	Performance Test Review
PVP	Payload Verification Plan
PWL	
R&MA	Reliability and Maintainability Assessment
RDMA	Risk Data Management Application
RE	
RID	Review Item Discrepancy
RPO	Research Program Office
RS	Reference Standard
SABER	
SAR	Stage Assessment Review
SAT	
SCIR	Station Cargo Integration Review
SCS	
SIA	Stowage Integration Agreement
SORR	Stage Operations Readiness Review
SPL	Sound Pressure Level
SSCCD	Space Station Crew Compartment Drawing
SSE	Station Support Equipment
TAPS	
TVFEM	
UCE	
VAR	Verification Acceptance Review
VES	Vacuum Exhaust System
VLA	Verification Load Analysis
WGS	Waste Gas System

PSIVF and KSC Acronyms

HELP !

PSIVF and KSC Acronyms

ABCL	As-Built Configuration List
C&DH	Command and Data Handling
CDR	Critical Design Review
CoFR	Certificate of Flight Readiness
DB	Database
DSCR	Data Set Change Request
DSM	Data Set Manager
ECL	Engineering Configuration List
ERU	Engineering Release Unit
GOWG	Ground Operations Working Group
GSDP	Ground Safety Data Package
HOSC	Huntsville Operations Support Center
ICD	Interface Control Document
IDP	Integration Data Package
IDRD	Increment Definition Requirements Document
IPRN	Interim Product Release Notice
LPM	Launch Package Manager
LSSP	Launch Site Support Plan
MBF	Mission Build Facility
MPLM	Multi Purpose Logistics Module
MSDS	Material Safety Data Sheet
OMRS	Operations and Maintenance Requirements and Specifications
PALS	Program Automated Library System
PCS	Portable Computer System
PDR	Preliminary Design Review
PIA	Payload Integration Agreement
PIFL	
PIM	Payload Integration Manager
PIMS	Payload Information Management System
PPIL	Payload Product Integrated List
PSCP	Payload Software Control Panel
PSIVF	Payload Software Integration Verification Facility
PTCS	Payload Test and Checkout System
PTP	Payload Tactical Plan
PWQ	
RAM	Requirements Allocation Matrix
RCN	Requirements Change Notice
SCM	Software Configuration Management
SIF	Software Integration Facility
SORR	Stage Operations Readiness Review
SQA	Software Quality Assurance
SRDS	
SSC	Station Support Computer
TGHR	Time-critical Ground Handling Requirements
TORR	Test Open Records Review
TRDS	
TRR	Training Readiness Review
VDD	Version Description Document

Payload Operations Integration Acronyms

Payload Operations Integration Acronyms

HELP !

AP	Automated Procedure
C&DH	Command and Data Handling
CAM	Crew Activity Manager
CDR	Critical Design Review
CEIT	Crew Equipment Integration Test
CM	Configuration Management
CMD	Command
CoFR	Certificate of Flight Readiness
COSS	Crew On - orbit Support Software
CPE	Crew Procedures Engineer
CPO	Command and PLMDM Officer
CPS	Consolidated Planning System
CQRM	Crew Qualification Requirements Matrix
CTC	Crew Training Catalog
DDPF	Decal and Design Production Facility
DGCS	Display and Graphics Commonality Standards
ECR	Engineering Change Request
EPAS	ETOV Payload Activity Summary
ERO	EXPRESS Rack Office
ExPCP	Execute Planning Control Panel
FOR	Flight Operations Review
FPD	Flight Projects Directorate
FR	Flight Rule
FRCB	Flight Rules Control Board
FRCR	Flight Rules Change Request
FUR	Facility Use Request
GAD	Ground Ancillary Data
GDS	Ground Data Services
GL&C	Guidelines and Constraints
Gr&C	Groundrules and Constraints
GSP	Ground Support Personnel
HCR	HOSC Change Request
HOSC	Huntsville Operations Support Center
ICD	Interface Control Document
IDRD	Increment Definition Requirements Document
IEPT	International Execute Planning Team
IMARS	
IMS	Inventory Management System
IPLAT	Integrated Payload Label Assessment Team
IPLFOR	Integrated Payload Flight Operations Review
iURC	interim User Requirements Collection
ITI	International Training Integrator
MCC	Mission Control Center
MIDAS	Mission Integration Database Application System
MITP	Multilateral Increment -specific Training Plan
MPLM	Multi Purpose Logistics Module
MPV	Manual Procedure Viewer
MR	Manifest Request
NISN	NASA Information Support Network
NPTP	NASA Payload Training Panel
OBT	On -Board Training
OBTWG	On -Board Training Working Group
OC	Operations Controller
OCPOC	Operations Controller Point Of Contact
OCR	Operations Change Request
ODF	Operations Data File
OOS	On -orbit Operations Summary
OPNOM	Operations Nomenclature
OSTP	On -board Short -Term Plan
PAYCOM	Payload Communicator
PDR	Preliminary Design Review
PDSS	Payload Data Support System
PEP	Payload Executive Processor
PHANTOM	Photo and TV Operations Manager
PIA	Payload Integration Agreement
PIRATE	Payload Imagery Requirements and Transit Evaluation Report
PLCR	Payload Lesson Change Request
PLMDM	Payload Multiplexer/ DeMultiplexer
PLOT	Payload Operations Techniques
POD	Payload Operations Director
PODF	Payload Operations Data File
PODFCB	Payload Operations Data File Control Board
POH	Payload Operations Handbook
POIC	Payload Operations Integration Center
PRD	Payload Requirements Document
PSIV	Payload Software Integration Verification
PSM	Payload Systems Manual
PSRD	Payload Simulator Requirements Document
PTDR	Payload Training Dry Run
PTLP	Payload Training Lesson Plan
PTP	Payload Tactical Plan
PTU	Payload Training Unit
PUDG	Payload User Development Guide
RICO	Real -time Information Control Officer
SDT	Shuttle Data Tape
SOC	Shuttle Operations Controller
SODF	Systems Operations Data File
SPIM	Stowage Payload Integration Manager
SSTF	Space Station Training Facility
STP	Short - Term Plan
TAF	Training Assessment Form
TDR	Training Design Review
TLM	Telemetry
TRR	Training Readiness Review
TSC	Telescience Support Center
TST	Training Strategy Team
VITT	Vehicle Integration Test Team